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Teton Dam Failure

failure, damage, lessons

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Teton Dam

- Located on the Teton River above Rexburg Idaho
- 305 ft high, 3,100 feet long earth embankment
- Proposed in 1963 by the Bureau of Reclamation and passed by congress without opposition
- Constructed for irrigation, flood control, and power generation
- $100 million construction cost

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Engineering

- Geology of the entire region is volcanic
- Fissured basalt and rhyolitic ash flow, highly permeable
- USGS surveys indicated the prevalence of the volcanic substrate, in addition to high potential seismicity. 5 earthquakes nearby in 5 years, 2 of significant magnitude.
- Geologic concerns downplayed during editing process of report preparation and submittal.
- Bureau planned grout curtains to seal abutments and base of dam.

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Constru

- During exc
  discovered
- Bureau per
  anticipated
  of keyway t
- Dam comp
- After heavy
  ft/day and a

utside

filling.

ed to 2

Rexburg Civil Defense Cave

June 3-4 1976

- Reservoir nearly full
- Only outlet ready for flow releases is emergency outlet works. No functioning gates yet in place.
- Three small seeps discovered downstream from toe of dam in right abutment. Clear water, bureau saw no cause for concern.

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June 5 1976

7:30 AM

- Turbidity from seep through right abutment noted

8:30 AM

- Seepage examined and estimated to be 20 – 30 cfs

9:30 AM

- Seepage estimated to be 40 – 50 cfs
- Project Construction Engineer (PCE) considered alerting area residents, but didn’t want to cause panic so decided otherwise.

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10:15 – 10:45 AM

- Wet spot on the embankment forms and rapidly begins to flow and erode embankment materials.
- Loud noise heard by several people
- Two bulldozers begin to push materials into the hole in the embankment
- PCE notifies 2 county sheriff's offices, advises of flooding, says prepare to evacuate.

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11:00AM – 11:30AM

- Whirlpool develops in reservoir
- Additional notification to sheriff's offices to evacuate areas below dam
- Efforts initiated to fill whirlpool
- Dozers slide into downstream hole in embankment – operators rescued

AFTER VAINLY TRYING TO FILL BREAK IN EMBANKMENT OF TETON DAM, TWO "CAT" OPERATORS BACK TOWARD SAFETY AS THEIR BULLDOZERS SLIDE INTO THE WIDENING GAP

PHOTOGRAPHS BY DALE HOWARD

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11:45AM

- Sinkhole forms on embankment near crest
- Dozers attempting to fill whirlpool removed and personnel flee dam

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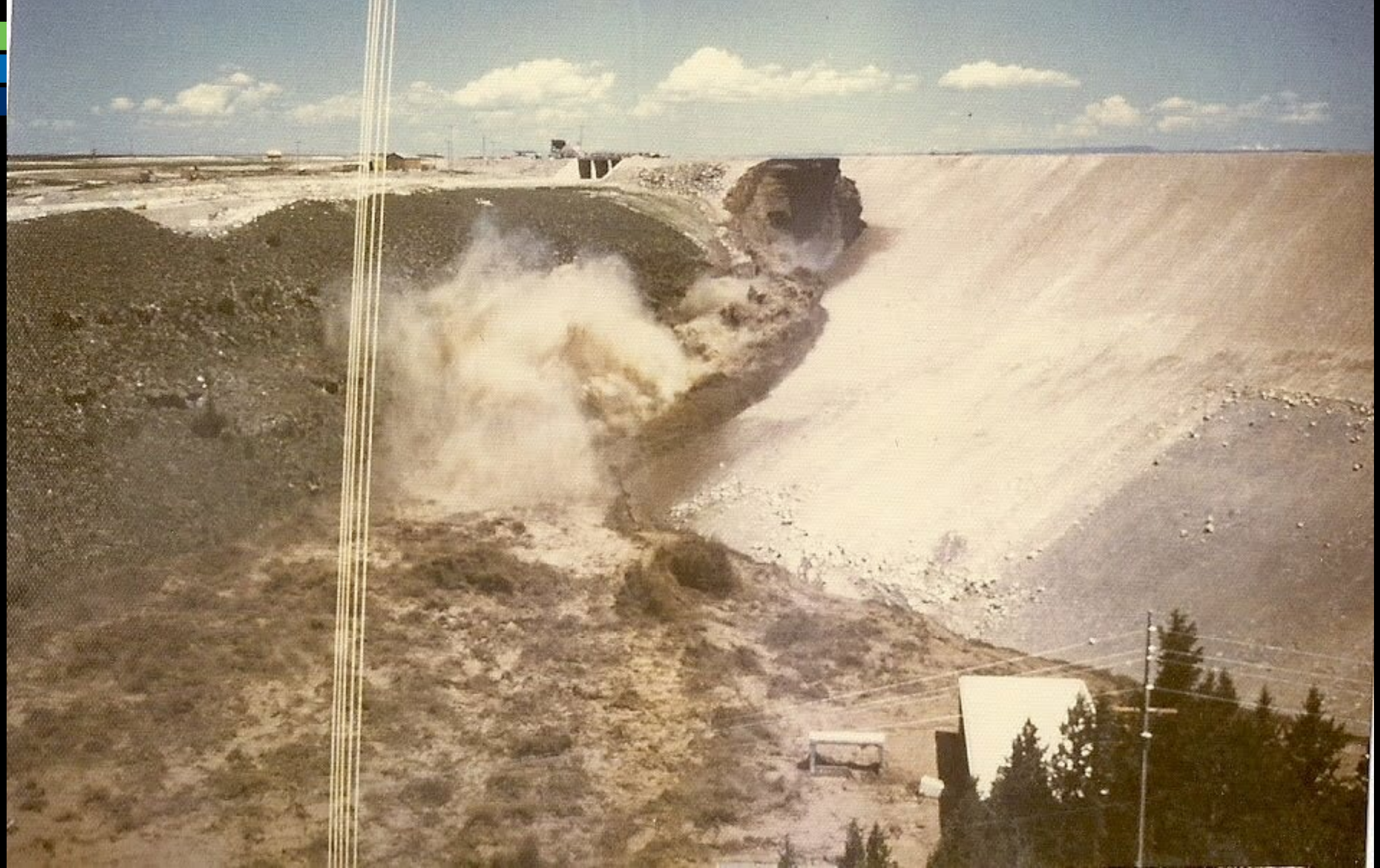

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Dam Crest collapses and falls into river

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Over 2 million CFS of sediment-
filled water released


Walker


Stephenson's
Market


Griffith
JEWELRY
CHEVROLET
OLDSMOBILE
BUICK
OPEL
TAYLOR
STOP


Bank


8:00 PM
Reservoir is completely emptied


BURGERS


Holbrook
West


YOUNG


SUGAR & SPICE
CANDIES


STOP
BUS LANE
20
191


FARM
BUREAU
INSURANCE
INCOME
TAX
H&BLOCK


First Security Bank


WELCOME TO ...
WRECKSBURG
DESIGNED & LANDSCAPED BY
DEPARTMENT OF INFERIOR
& BUREAU OF WRECKLAMATION
HELP!
BUREAU
WRECK
CLAIMATION

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Damages

- 11 deaths
- 13,000 head of cattle lost
- In Rexburg area 80% of existing structures damaged
- Teton River ecology decimated
- Native cutthroat trout population endangered
- Damage estimates range up to $2 billion
- Claims program ended in 1987 with 7,563 claims paid for a total of $322 million (>$1.7B in today's $)

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Investigative Panel

- Panel assembled by governor of Idaho and secretary of interior
- Composed of prominent civil and geotechnical engineers
- Investigation included field excavation down to grout curtain and extensive lab testing
- Issued report in December 1976

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Panel Findings

- The pre-design site and geologic studies were appropriate
- Construction was carried out properly and conformed with design
- Differential settlement and seismicity were not factors
- Grout curtain was not extensive enough, and overall structure relied too heavily on it, no redundancy
- Failure Mechanism:
  - Fissures and cracks in the rhyolite abutments allowed seepage which in-turn caused internal erosion
  - Loess soil used in the core was permeable and highly erodible

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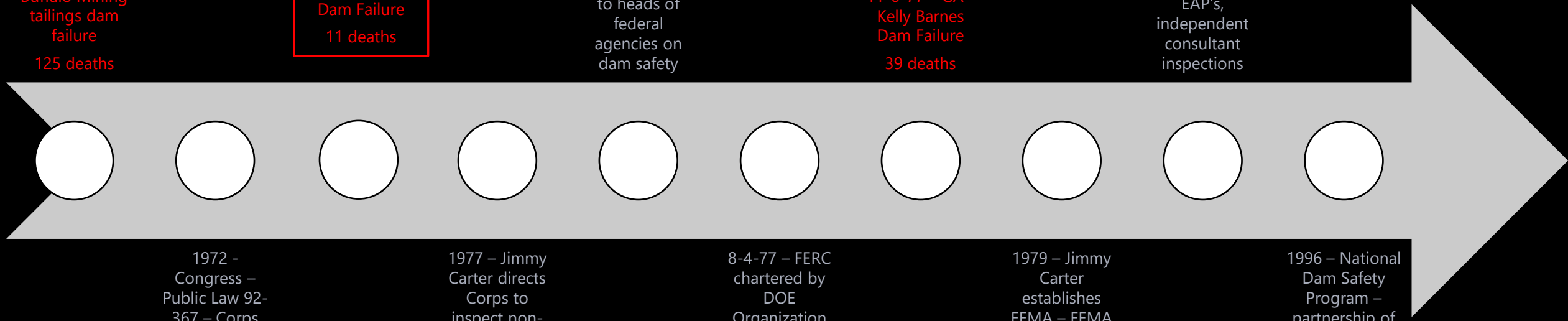
Landmark Regulatory Impacts



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Lessons

- Dam safety is just as critical for new structures as old
- Early notification saves lives – Emergency Action Plans matter
- Bias, confidence, and arrogance don’t benefit dam safety
- Catastrophic consequences can manifest without dam failure
- Consider the swiss cheese model for risk management

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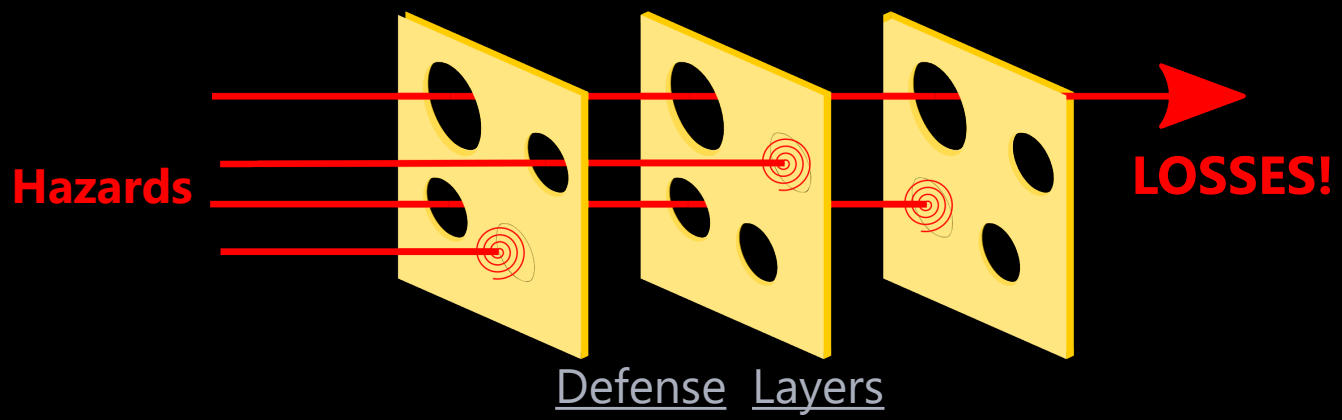
Swiss Cheese Model

- In complex systems, defense layers stop hazards from creating losses (failures).
- No defense is 100% perfect, so holes exist in each layer.
- Risk is reduced by increasing number of defense layers, or by closing holes in (improving) existing layers.
- The effective manager of risk:
  - Acknowledges their defenses are not perfect
  - Continually strives to improve their layers of defense
  - Seeks out new perspectives and new understanding of hazards



- Design
- Conservatism
- Quality Control
- Inspections
- Reporting
- Maintenance
- Operations
- Emergency response
- Emergency Action Plans
- Etc.

(SK1)-REXBURG, Idaho, June 6--DISMAY IN FLOODED HOME--Mr. and Mrs. Lauren Williams sit in the flooded Rexburg home of Mrs. Williams' mother, Thelma Williams, and view the damage caused by waters released by a collapsed dam. The floor is covered by mud and furnishings are ruined. The line showing the depth reached by the now-receded water is visible on the wall and drapes. (AP WIREPHOTO)(See AP Story)(JB1837Tribune) 1976